Analysis of Legislation Pertaining to the Control and Management of Exotic Aquatic Species in Canadian and Adjacent United States Waters

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ANALYSIS OF LEGISLATION PERTAINING TO THE CONTROL AND MANAGEMENT OF EXOTIC AQUATIC SPECIES IN CANADIAN AND ADJACENT UNITED STATES WATERS

by

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ABSTRACT

Canadian and American legislation was examined at all levels to determine if there were provisions for the control of exotic aquatic species (EAS) introduced into their common waters of the Atlantic, Pacific, and Great Lakes region. No Canadian laws exist to allow rapid control management of EAS, but several federal laws could be amended to authorize such action. By contrast, U.S. federal and state laws allow control EAS in ballast waters, but no provisions yet exist to permit control of EAS introduced from other sources. Greater international shipping trade with all regions of North America, growth of aquaculture and live fish sales, and global warming of freshwaters mean that further introductions of EAS are to be expected. Thus a bilateral and harmonized regulative approach to EAS control is required.

Keywords: Legislation, exotic aquatic species, Canada, United States, control, management

RÉSUMÉ

Les législations canadiennes et américaines ont été examinées à tous les niveaux pour déterminer s'il y avait des prestations pour le contrôle des espèces non indigènes (NIS) introduites dans leurs eaux communes de l'Atlantique, du Pacifique, et de la région des Grands Lacs. Il n'existe aucune loi canadienne qui permet une gestion à contrôle rapide des NIS, mais plusieurs lois fédérales pourraient êtres amendées pour authoriser une telle chose. Par contraste, les lois américaines fédérales et les lois des États permettent le contrôle des NIS dans l'eau des ballasts, mais il n'existe encore aucune prestation pour permettre le contrôles des NIS introduits par d'autres sources. Plus de commerce de transport international avec toutes les régions de l'Amérique du Nord, plus d'augmentation des ventes de poissons vivants et d'aquaculture, et plus d'effets de serre dans les eaux douces indiquent que d'autres introductions des NIS sont prévisibles. Donc, une approche règlementée bilatérale et harmonisée pour le contrôle des NIS est nécessaire.

Mots clés: Législation, espèces non indigenes, Canada, États Unis, gestion

EXECUTIVE SUMMARY

The capacity of Canadian and American legislation to manage exotic aquatic species (EAS) in their contiguous boundary waters was analyzed for the Atlantic, the Great Lakes, and the Pacific regions of North America. The analysis was conducted at the level of international treaties, bilateral treaties and agreements, federal legislation, and provincial and state laws. The legislation was examined for its capacity to implement management of EAS originating from ballast water, bait fish, aquaculture and fish trade.

Several international and bilateral treaties and agreements require Canada to take action against EAS, but no federal legislation exists to mandate such action: only federal guidelines exist. Several federal Acts, notably the *Fisheries Act*, could if suitably amended by a re-definition of terms, and explicit reference to EAS, be used to authorize management of EAS in Canada. No province has enacted legislation for ballast water that allows management against EAS to proceed. However, the Vancouver Port Authority has implemented progressive regulations to manage ballast water in shipping. Aquaculture is quite heavily regulated in the provinces examined, but a large gap still exists for the management of EAS through secondary vectors, especially the fish sales/fish markets and aquarium pet trade industries.

The USA and its member States have enacted far more legislation than Canada to deal with EAS from ballast water and also to regulate EAS introductions and spread through secondary vectors. When pending US federal laws requiring no-ballast-on-board (NOBOB) vessels to be inspected is implemented, the possibilities of EAS arriving in ballast water will be reduced considerably. None of the Canadian federal and provincial legislation examined contained provisions that could authorize a fast-action type of management to contain and eradicate newly-discovered EAS from aquaculture and the exotic fish trades. Similarly, the legislation of USA, while emphasizing prevention, also lacks the capacity to authorize fast-action management of newly-released EAS from the same sources.

Given the possibility of further introductions of EAS, there is need for legislative change in Canada and its provinces not only to prevent introductions from different sources, but also to deal effectively with them when they are detected. It is recommended that Canada convert its voluntary ballast water management guidelines to mandatory regulations under the *Canada Shipping Act*, and align its regulations with new (September, 2004) mandatory regulations of the USA. It is further recommended that amendment of the *Fisheries Act* be undertaken to provide the enabling legislation for all aspects of fast action management and control of selected EAS. Such an amended *Fisheries Act* could discharge Canada's international and bilateral obligations to manage invasive exotic species. The updating of provincial legislation to deal more effectively with exotics from aquaculture, fish marketing, bait fish use, and the pet fish trade, is strongly encouraged to complement, and be aligned with, revised federal laws.

SOMMAIRE

La capacité des législations canadiennes et américaines de gérer les espèces non indigènes (NIS) dans leurs eaux frontalières contiguës a été analysé pour le Pacifique, les Grands Lacs et les régions Atlantiques de l'Amérique du Nord. L'analyse a été menée aux niveaux des traités internationaux, des accords et des traités bilatéraux, de la législation fédérale, et des lois de la province et de l'état. La législation a été examinée pour sa capacité de mettre sur pied la gestion des NIS qui sont d'origine de l'eau des ballasts, de poissons appâts, de l'aquaculture et de la pêcherie.

Plusieurs traités et accords internationaux et bilatéraux demandent au Canada de prendre des mesures contre les NIS, mais aucune législation fédérale n'existe pour mandater une telle chose: il n'existe que des directives fédérales. Plusieurs lois fédérales, notamment la *Loi des Pêcheries*, pourraient si convenablement amendées par une re-définition des termes, et par des références explicites aux NIS, êtres utilisées pour authoriser la gestion des NIS au Canada. Aucune province n'a adopté une législation pour l'eau des ballasts qui permet la gestion contre les NIS de continuer. Cependant, l'Administration Portuaire de Vancouver a mis sur pied des règlementations progressives pour gérer l'eau des ballasts pendant le transport. L'aquaculture est très règlementée dans les provinces examinées, mais un grand écart existe encore pour la gestion des NIS par des vecteurs secondaires, surtout pour les industries dans la vente/le marché des poissons, et le commerce de poissons d'aquarium.

Les É.-U. et ses États membres ont adopté beaucoup plus de législations que le Canada pour s'occuper des NIS de l'eau des ballasts et aussi pour règlementer l'introduction et l'épandange des NIS à partir de vecteurs secondaires. Lorsque des lois fédérales américaines (en instance), qui requiert les navires sans aucun lest d'eau à bord (NOBOB), seront adoptées, les possibilités que les NIS arrivent dans l'eau des ballasts seront considérablement réduites.

Aucune des législations fédérales et provinciales du Canada qui ont été examinées ne contenaient de prévisions qui pourraient authoriser une réaction rapide de la gestion pour maîtriser et éradiquer de nouveaux NIS. De même, bien que la législation des É.-U. insiste sur la prévention, elle manque aussi la capacité d'authoriser une réaction rapide de la gestion de nouveaux NIS.

Étant donné qu'il y a la possibilité de continuer l'introduction des NIS, il y a un besoin pour des changements législatifs au Canada et dans ses provinces, pour non seulement prévenir l'introduction par des sources différentes, mais aussi pour se charger d'elles avec efficacité quand elles sont détectées. Il est recommendé que le Canada convertisse ses directives volontaires pour la gestion de l'eau des ballasts en règlementations mandatoires sous la *Loi de la Marine Marchande*, et d'aligner ses règlementations avec les nouvelles (Septembre, 2004) règlementations mandatoires des E.-U.. Il est aussi recommendé que l'amendement de la Loi des Pêcheries soit pris en charge pour fournir les législations habilitantes dans tous les aspects de la gestion à réaction rapide et du contrôle des NIS choisis. Une telle *Loi des Pêcheries* modifiée pourrait acquitter les obligations internationales et bilatérales du Canada en ce qui concerne la gestion des espèces invasives exotiques. La mise à jour des législations provinciales pour mieux contrôler les espèces exotiques de l'aquaculture, de la vente de poissons, de l'utilisation des poissons appâts, et du commerce de poissons d'aquarium, est fortement encouragée pour complémenter, et être alignée avec, les lois fédérales révisées.

INTRODUCTION

Many aquatic and terrestrial exotic species have been introduced to North America during the past 200 years by various means that are usually associated with human-related activities. Some became invasive and negatively impacted Canada's native species and their ecosystems (Mosquin et al. 1995, Ricciardi 2001, Colautti et al. 2003). The rate of introductions and costs attributed to their effects can be associated with the increase in commercial travel (Levine and D'Antonio 2003). Pimental et al. (2000) estimated that the exotic zebra mussel (*Dreissena polymorpha*) and Asiatic clam (*Corbicula fluminea*) in the Great Lakes and their U.S. tributaries accounted for $1.1 billion U.S. in damage and control costs annually, and the cost is growing. Exotic species costs in Canada were estimated to be $7-20 billion to the forest industry, and $5-14 billion to the agriculture industry (MacIsaac et al. 2003).

Studies largely based on terrestrial species introduced to the United Kingdom indicated about 10% of the exotics introduced became established, and 10% of those established became invasive (Williamson and Brown 1986, Simberloff 2002). The increase in rate of EAS introductions and economic losses attributed to their effects over the last few decades would indicate that efforts to deal with exotic species have had limited success (Bright 1998). Due to their prevalence and impact on a global scale, Article 8(h) of the *United Nations Convention on Biodiversity* was adopted in 1992, which requires all Parties and Signatories to undertake measures to deal with exotic species. Canada has ratified this Convention, and therefore is obligated to create legislation that enables it to discharge its responsibilities.

Exotic aquatic species (EAS) introductions are often accidental or incidental, and species are often reported after they have become well established. The scope of understanding the problems associated with exotic species has increased in Canada since the U.N. Convention came into force, such that Goal 1(E) of the *Canadian Biodiversity Strategy* (1995) is to develop legislation, policies, and plans to prevent exotic organisms from having a negative impact on Canadian biodiversity. The United States is not a Party to the U.N. Convention, and therefore is not obliged to create legislation for exotic species. The U.S. does however have a strong program for EAS, including policy and legislation at a range of jurisdictional levels. Both countries share the northeastern Atlantic, Great Lakes, and northwestern Pacific regional waters of North America, therefore their policies and legislation for EAS should be consistent and complementary in order to deal effectively with common EAS problems. EAS refer to species that are non-native to these waters shared by both countries.

Canada's freshwater and marine habitats have experienced many unintentional introductions of EAS (Mills et al. 1993, Levings et al. 1998). A workshop held by the International Joint Commission and the Great Lakes Fishery Commission in 1990 was instrumental in identifying the role of overseas vessels in EAS introductions to the Great Lakes, and the need to impose a ballast water exchange program (IJC-GLFC 1990). Vessel related transport of organisms found in ballast water, tank sediment and hull fouling are important means for introducing EAS to new regions, as well as secondary transport to regional waters (Carlton and Geller 1993, Mills et al. 1993, Ricciardi and MacIsaac 2000). EAS can also be introduced and spread through aquaculture escapes, and baitfish and food fish releases (Welcomme 1984). A survey of baitfish held by dealers in Ontario indicated 18 of the 28 speices found were potentially outside their known ranges (Litvak and Mandrak (1993). Examination of baitfish regulations also indicated 11 of 12 north central U.S. states allowed out of state transport (Meronek et al. 1995). Aquarium trade release is an important

source in the U.S. accounting for one in every four fish introduced (Reeves 1999, Dextrase and Paleczny 2000). Other means of unintentional introductions like recreational boating and canals examined by Vásárhelyi and Thomas (2003) were not elaborated on in this report.

Current Canadian and U.S. regulations and guidelines based on ballast water exchange have not been effective in significantly reducing vessel related introductions. New introductions and spread of established species continue to be reported along the northern Atlantic and Pacific coasts, and the Great Lakes (Chapman et al. 2002, Levings et al. 2002, Grigorovich et al. 2003). American ballast water regulations were developed to deal with vessels that carry large volumes of exchangeable water, but were not designed to deal with smaller volumes. Over 80% of overseas vessels entering the Great Lakes will declare no ballast on board (NOBOB) even though over 50 cubic meters of residual ballast my be carried (Niimi and Reid 2003). The U.S. recently added provision (33 CFR Part 151 subparts) to the *Nonindigenous Aquatic Nuisance Prevention and Control Act* (1990) in July, 2004 (Department of Homeland Security 2004) that requires mid-ocean ballast exchange, retention of unexchanged ballast on board, or use of an approved alternative management plan, for vessels entering U.S. ports. These requirements are similar to those required by overseas vessels entering the Great Lakes since 1993, with additional requirements for better vessel maintenance and information filing procedures.

Many EAS have become integrated into the biological communities to which they were introduced. A few have become invasive, and measures to reduce their impact have generally had limited success. The problem becomes critical when an invasive species is introduced to a new region, and can expand its range to nearby waters. There have been several cases where invasive EAS that were recently introduced to Australia and California were successfully eradicated due to rapid responses by the agencies responsible which provided the authorization and resources required (Ferguson 2000, Anderson 2002). These cases demonstrated clearly the need for additional legislation to develop rapid response capabilities to deal with potentially urgent environmental concerns arising from exotics and undesirable aquatic species.

A number of studies have examined policies, statutes and regulations related to unintentional introductions and subsequent spread of EAS for different jurisdictions in Canada and the U.S. (Wade 1995, Glassner-Shwayder 1999, Levings 1999, Reeves 1999, Donihee and Netherwood 2001, Cosgrove 2002, Alexander 2003, Vásárhelyi and Thomas 2003).

This report will examine existing legislative provisions in both countries at the federal, provincial and state levels that share adjoining waters to determine if comparable legislation is available to manage EAS in adjacent jurisdictions. The primary role of these regulations is to reduce the risk of EAS introductions to North America through various means. This report will also examine existing current legislation in Canada and the U.S. to determine if authorization is currently available for agencies to effectively deal with EAS issues. These would include authorization to control, contain and eradicate species that could be applied as a rapid response program when that need is required.

SCOPE, METHODOLOGY AND FORMAT

This report builds upon previous studies (Wade 1995, Glassner-Shwayder 1999, Levings

1999, Reeves 1999, Donihee and Netherwood 2001, National Invasive Species Council 2001, National Workshop on Alien Invasive Species 2001, Cosgrove 2002, Alexander 2003, Vásárhelyi and Thomas 2003, among others) by expanding on the issue of unintentional introductions of EAS. The report also includes an analysis of Canadian and U.S. statutes and regulations at the federal and provincial/state levels dealing with the fast-action response, an issue that until now has not been examined in detail.

Two important factors that will affect the risk of introduction and spread by EAS are early detection and a fast action response to new invaders. Reducing the spread of a species is critical because of the difficulties of conducting an eradication program. There have been several successful eradications of an invasive EAS but only because of the rapid actions that allowed treatments to be applied. The emphasis for managing EAS is on prevention, first to prevent EAS from entering the ecosystem, and then to prevent spread of any new EAS beyond its site of entry. This is completely consistent with the application of the Precautionary Principle, especially as it relates to the associated costs/benefits of prevention (Kuntz-Duriseti 2004) and early response to invasive species.

The framework of this report is based on the paper by Vásárhelyi and Thomas (2003). It has been expanded to include a short summary and assessment of legislation and regulations dealing with EAS in Canada and the U.S. at the bilateral, federal, and provincial/state levels along the Atlantic, Great Lakes, and Pacific regional waters shared by both countries. These include Newfoundland and Labrador, Nova Scotia, Prince Edward Island, New Brunswick and Maine along the Atlantic coast; Quebec, Ontario, New York, Pennsylvania, Ohio, Michigan, Illinois, Indiana, Wisconsin and Minnesota that border the Great Lakes; and British Columbia and Washington along the Pacific coast. Canadian and U.S. water quality-type legislation was also examined to determine if they could be used to deal with EAS issues after a re-definition of terms or additional amendment, thereby providing the authority to act. This report is confined largely to "hard laws" i.e. laws that have regulations that are legally enforceable (Lyster 1985). "Soft laws", such as agreements, codes, strategies, or established policies are not legally-binding, and have, generally, not been included in this analysis. Bilateral agreements are the only exception, simply because such agreements often have an assumed power comparable to laws.

This report examines the strengths and weaknesses of the statutes and regulations that may allow unintentional introductions of EAS through (i) ballast water, (ii) aquaculture, (iii) fish sales/fish markets, (iv) baitfish, and (v) aquarium pet trade. Analysis is limited to vertebrate and invertebrate organisms, and does not include plants, fungi, bacteria and viruses. A list of all the legislation examined in this study is reported in Appendix 1.

The need for regulatory agencies to have rapid response action capability to deal with EAS is recognized as a priority issue. This capability is already available to deal with natural disasters such as forest fires, and existing regulations will be examined to determine if they could be extended to include EAS problems. Several successful EAS eradications are described in depth to identify the legislative needs that must be available to allow the designated agencies to act as needed.

Regulations passed by federal governments are usually enforced by federal agencies, unless that authority is delegated to the province or state. This report does not examine the roles of federal and provincial government agencies that could be responsible for EAS management and control, since that is the prerogative of government.

LEGISLATIVE COMPARISON AMONG NORTHEASTERN ATLANTIC, GREAT LAKES, AND NORTHWESTERN PACIFIC JURISDICTIONS IN NORTH AMERICA

Bilateral Legislation and Agreements

The *International Boundary Waters Treaty Act* (IBWTA) (1910) (R.S. 1985, c. 1-17) and *Great Lakes Water Quality Agreement* (GLWQA) (1972, as amended in 1978, 1983, and 1987) may be applied to EAS management in the Great Lakes. Article IV of the IBWTA provides provisions for the International Joint Commission to deal with pollution of boundary waters. If EAS were considered a form of water pollution, then provisions for their regulation may be issued under the IBWTA. The GLWQA deals specifically with freshwater issues in the Great Lakes, and its purpose is to restore the ecological integrity of the Great Lakes basin (Article II). However, the ecological integrity of the Great Lakes cannot be realized unless provisions exist for EAS management and aquatic habitat restoration.

The *North American Agreement for Environmental Cooperation* (NAAEC) (1993) is the environmental adjunct to the *North American Free Trade Agreement*. The NAAEC may be applied to EAS control and management in the Great Lakes and the waters of the northeastern Atlantic, and northeastern Pacific coasts. Under the NAAEC, the Council of the Commission on Environmental Co-operation may develop recommendations for exotic species (Article 10(2)(h)). The NAAEC applies generally to EAS and could be used to develop recommendations for a bilateral approach for unintentional introductions and spread of EAS by the vectors specified in this study, and also can address the issue of a fast action response to newly discovered, potentially deleterious EAS. The NAAEC is only an agreement, and is, therefore, not legally binding. However, it could be used to develop a consistent and complementary framework for management of EAS between Canada and the U.S., under which current legislation may be amended or new legislation developed.

The *Convention on Great Lakes Fisheries* (1954) was originally established with the purpose of controlling and eradicating the invasive sea lamprey (*Petromyzon marinus*) from the Great Lakes region. It established the Great Lakes Fishery Commission (GLFC), whose role is to control and manage sea lamprey in the Great Lakes region. This Convention would be more useful if it were amended to include other types of EAS. Additionally, the CGLF could be strengthened if the GLFC were provided the regulatory authority to control and manage EAS under the Convention.

The *United Nations Conference on Environment and Development* (UNCED) (1992) (Agenda 21) includes a number of sections that apply to exotic species control and management through intentional and unintentional introductions, including ballast water. Chapter 15 deals with conservation of biodiversity, in which the introduction of EAS is acknowledged to have and continues to contribute to biodiversity loss. The UNCED requires nations to adopt appropriate regulations for ballast water discharge to prevent the spread of non-indigenous organisms (17.30(vi)). The UNCED also states that legislation should be strengthened for aquaculture (17.79(d)), and measure should be put into place to aid in preventing the introduction of new species through aquaculture (17.83). Therefore, Agenda 21 could be used by Canada to develop ballast water regulations, and to strengthen current aquaculture regulations.

CANADIAN AND U.S. FEDERAL LEGISLATION FOR EXOTIC AQUATIC SPECIES CONTROL AND BALLAST WATER MANAGEMENT

Canadian General Legislation

The *Fisheries Act* (R.S. 1985, c. F-14) contains provisions for both habitat protection and pollution prevention as they apply to the management of fisheries and the conservation of fish (Vásárhelyi and Thomas 2003). This Act prohibits the deposition of a deleterious substance in water frequented by fish (s. 36). Water containing EAS that is thrown overboard and deposited into the Great Lakes may be viewed as deleterious (s. 36 (1)a). However, deleterious substances are not clearly defined in this Act, and are subject to designation.

Cosgrove (2002) identified pertinent sections of this Act and examined how they could be applied to EAS control and management. Section 43 relates to regulatory authority, and various limitations to developing regulations under this Act were identified. Additionally, s. 36 referring to "deleterious substances" and the use of the term "deleterious substance" as a tool to eradicate/control aquatic invasive species was examined. Activities such as throwing ballast overboard may be viewed as "deleterious" because the water may contain EAS (s. 36(1)a). However, deleterious substances are not clearly defined in this Act. A redefinition of the term "deleterious" to include EAS would allow for provisions to control EAS especially through ballast water regulations. Cosgrove (2002) proposed that s.43 of this Act be amended to provide regulatory authority to the Governor in Council to manage for aquatic invasive species. If the authority to regulate were included, then regulations could be passed under s. 43 for the management of EAS (including prevention and eradication measures).

The purpose of the *Canada Water Act* (R.S. 1985, C-11) is to promote research and implement programs for the conservation and use of fresh water. This Act deals with issues of water pollution, primarily as forms of chemical waste, and does not mention EAS. However, a redefinition of the term "waste" in the Act to include "any substance or biota" would allow for provisions for the prevention and control of EAS to be developed. For a detailed review of this Act and its applicability to EAS refer to Vásárhelyi and Thomas (2003).

The *Canada Wildlife Act* (R.S. 1985, c. W-9) does not include any sections that address EAS, or any sections that could be applied to EAS prevention or management.

Another related document is the *National Code on Introductions and Transfer of Aquatic Organisms* (2003) which deals with the introduction and transfer of aquatic organisms between provinces and territories, or within them. The purpose of the Code is to provide a consistent, science-based approach to protecting aquatic ecosystems at all jurisdictional levels in Canada. The Code deals mainly with intentional introductions and transfer of aquatic organisms, and does not deal with accidental introductions, for example through ballast water discharge. The Code also does not cover federal and provincial Acts, regulations and policies relating to aquarium fish, bait fish, and live fish for the food market. However, it may be applied to the introduction and transfer of aquatic organisms through the aquaculture industry, and therefore, it has some application to the study. The Code stresses the need for a consistent and complementary approach among the federal and provincial/territorial jurisdictions of Canada for the conservation of aquatic ecosystems.

U.S. General Legislation

The *Lacey Act* (1900) and how it applies to EAS prevention and control, specifically to the possession, transport, and sale of species, has been examined and summarized by Wade (1995), Reeves (1999), and Alexander (2003).

Executive Order 13112 (Federal Register 1999) was signed by President Clinton in 1999 and required U.S. federal agencies to prevent and manage the introduction and subsequent spread of exotic species through the development of different programs. Perhaps one of the most important components of this Order was that it established the National Invasive Species Council, which was assigned the preparation of a national invasive species management plan. The council is currently at various stages of implementation of the National Invasive Species Management Plan (National Invasive Species Council 2001). This plan recognizes the important role that individual states play in management of invasive species within their borders. Therefore, the national plan requires that all U.S. states develop their own management plans to deal with invasive species (National Invasive Species Council 2001). The states included in this report have all developed their own management plans to deal with invasive species.

Both the *Great Lakes Fish and Wildlife Restoration Act* (1990), and *Great Lakes Legacy Act* (2002) apply very generally to conservation and management in the Great Lakes region. Neither piece of legislation includes any sections that address EAS, or any sections that could be applied to EAS prevention or management.

Ballast Water Legislation

The transportation of EAS via ballast tanks of oceanic vessels was identified as a significant environmental and economic issue, and the U.S. addressed this issue by enacting the *Nonindigenous Aquatic Nuisance Prevention and Control Act* in 1990. This Act was established mainly to address the zebra mussel invasion in the Great Lakes, but applies generally to EAS prevention and control through unintentional introductions via ballast water. In 1993, mandatory regulations were implemented under this Act (U.S. Coast Guard 1993). These regulations would apply to all vessels entering the Great Lakes and Hudson River from outside the 200 miles Exclusive Economic Zone (EEZ). Ships entering the Great Lakes with ballast on board are usually inspected at Massena, NY, which is located in the international section of the St. Lawrence Seaway which is administered by Canada and the U.S.

The *U.S. National Invasive Species Act* (NISA) (1996) (16 U.S.C. 4701-4702, 4711, 4722, 4751 *et seq.*, §§ 1101-1104, 1202, 1203) amended the *Nonindigenous Aquatic Nuisance Prevention and Control Act* to include additional regulations to prevent the introduction and spread of EAS via ballast water. An important aspect of NISA was that it expanded the ballast water issue to a national level. Voluntary guidelines were developed under the NISA for all ships entering U.S. ports outside of the EEZ. Section 2(e)1 of the NISA requires that information be collected regarding the adherence of vessels to ballast water guidelines, changes in ballast delivery, and the rate of invasion via ballast water. Sections 2(E)(i, ii) of the NISA address the issue of reducing the introduction of EAS from NOBOB vessels. However, no specific guidelines have been developed under section 2(E)(i, ii) for NOBOB vessels. This is an important loophole in NISA because there remains a threat of further introductions and spread of EAS from residual water and sediment in the ballast tanks of NOBOB vessels (Niimi and Reid 2003).

Two federal bills have been proposed in the U.S. related to EAS in the Great Lakes, and

are currently in the legislative process (Table 1). Both bills propose amendments to the *Nonindigenous Aquatic Nuisance Prevention and Control Act* to ensure that ships entering the Great Lakes do not discharge ballast water or sediment contaminated, or potentially contaminated with EAS. For a detailed summary of the bills refer to Vásárhelyi and Thomas (2003). At the time of publication of this report, the status of the two proposed bills is still pending.

Table 1. Canadian federal general and ballast water legislation examined for its potential to manage EAS, and existing U.S. federal legislation dealing generally with EAS management.

COUNTRY	LEGISLATION
Canada	
General	*Fisheries Act* (1985)
	Canada Water Act (1985)
	Canada Wildlife Act (1985)
Ballast water	*Canada Shipping Act* (2001),
U.S.	
General	*Lacey Act* (1900)
	Executive Order 13112 (1999)
	Great Lakes Fish and Wildlife Restoration Act (1990)
	Great Lakes Legacy Act (2002)
Ballast water	*Nonindigenous Aquatic Nuisance Prevention and Control Act* (1990)
	National Invasive Species Act (1996)
	National Aquatic Invasive Species Act of 2002 H.R.1080 (pending bill)
	Great Lakes Ecology Protection Act of 2003 S., H.R. 989 (pending bill)

Canada adopted the *Guidelines for the Control of Ballast Waters From Ships in Waters Under Canadian Jurisdiction* (TPE 13617E, September 20, 2000) on September 1, 2000. These guidelines are in response to the International Maritime Organization Resolution A.868(20), and supercede the *Voluntary Guidelines for the Control of Ballast Water Discharge* developed in 1989. These guidelines apply to all vessels entering Canadian waters, and are complementary to the U.S. Coast Guard regulations. Canada, however, has not developed mandatory regulations for ballast water exchange.

The *Canada Shipping Act* (2001, - c.-26) includes provisions for pollution prevention and the discharge of ballast water from oceanic vessels. On the recommendation of the Minister, the Governor may make regulations to protect the marine environment, including regulations for the control and management of ballast water (s. 190(1)(f)). Regulations may also be made "for preventing or reducing the release by vessels into waters of aquatic organisms or pathogens that, if released into those waters, could create hazards to human health, harm

organisms, damage amenities, impair biological diversity or interfere with legitimate use of the water" (s. 190(1)(g)). One major loophole is that although this section contains provisions to develop mandatory regulations for ballast water exchange, it is not mandatory because of the discretionary power of the Governor.

PROVINCIAL AND STATE LEGISLATION FOR EXOTIC AQUATIC SPECIES CONTROL AND MANAGEMENT

A number of provinces and states examined in this study have also enacted or proposed legislation related to ballast water discharge via oceanic vessels (Table 2). Refer to Vásárhelyi and Thomas (2003) for a detailed examination of Great Lakes provincial/states legislation for ballast water. However, the regulations developed by the U.S. Coast Guard (1993) apply to all vessels entering the Great Lakes, so introductions of EAS via ballast water are mitigated in the Great Lakes region. Additionally, the voluntary U.S. guidelines developed under the NISA, and the voluntary Canadian guidelines developed in response to the International Maritime Organization Resolution A.868(20) ensure that all Canadian and U.S. ports are covered to some degree with respect to ballast water issues. Legislation and regulations for ballast water at the state jurisdictional level are therefore, simply complementary to existing federal initiatives, but are important to help alleviate the problem of EAS introductions and spread to inland waters.

The State of Washington has enacted legislation for ballast water management and control (WAC 220-77-090), and for a ballast water discharge standard approval process (WAC 220-77-095). The intent of WAC 220-77-090 is to complement the U.S. Coast Guard Ballast Water Management Program developed under the *Ballast Water Regulations*. WAC 220-77-090 applies to vessels that discharge ballast water into Washington State waters (s. 1(a,b)), and it also provides direction for vessels that do not intend to discharge ballast water (s. 2ai, ii, (b) 3).

In addition to provincial/state legislation and regulations, individual harbor ports may have their own legislation and regulations in place to prevent the introduction of EAS via ballast water. In 1997, the Vancouver Port Authority in British Columbia developed a mandatory ballast water program to reduce the risk of EAS entering waters under its jurisdiction. Procedures for ballast water exchange can be found at the Port of Vancouver (2004). This was the first Canadian port to develop a mandatory ballast water exchange program, and remains one of the few that have one. This confirms the commitment of the port to prevent new introductions of EAS and for environmental protection in general. This protocol has also been adopted by the ports of Fraser (New Westminster) and Nanaimo. Similar programs have not been developed for Canadian ports on the eastern Atlantic coast that experience heavy shipping traffic such as the Port in St. John's, NL (Pers. comm. Capt. H. Flight, Harbormaster, Port of St. John's). Instead, ports in these provinces rely on the Canadian "Guidelines for the Control of Ballast Waters From Ships in Waters Under Canadian Jurisdiction" (TDE13617E) issued in September, 2000 to prevent the introduction of EAS into waters under their jurisdictions.

Table 2. Proposed and enacted provincial and state legislation for the northeastern Atlantic, Great Lakes, and northwestern Pacific jurisdictions pertaining to control of EAS introductions via ballast water. Legislation is identified as House Bill (H.B.), Senate Bill (S.B.), House File (H.F.), and Assembly Bill (A.B.) and no legislative action (None).

PROVINCE/STATE	BALLAST WATER LEGISLATION
Newfoundland and Labrador	None
Nova Scotia	None
Prince Edward Island	None
New Brunswick	None
Maine	None
Quebec	None
Ontario	None
New York	A.B. 02337, S.B. 01164
Pennsylvania	None
Ohio	None
Michigan	S.B. 152, H.B. 4189, H.B. 4248
Illinois	H.B. 3009
Indiana	None
Wisconsin	A.B. 437
Minnesota	H.F. 2554
British Columbia	None
Washington	Chapter 220-77 WAC

Provincial General Statutes and Regulations for Aquaculture, Fish Sales/Fish Markets, Baitfish, and Aquarium Pet Trade

Newfoundland and Labrador

General statutes and regulations

Sections 7(1,2) of the *Environmental Protection Act* (2002 c. E-14.2) state that "A person shall not release or permit the release of a substance into the environment in an amount, concentration or level or at a rate of release that causes or may cause an adverse effect." Due to the specific wording used in this section, the Act likely applies to chemical contaminants. However, a number of definitions for "substance" are provided in the Act, two of which may be applied to EAS. The term "substance" in the Act is defined as "matter that may become dispersed in the environment" (2)(jj)(i), and "an organism, whether or not it is living: (2)(jj)(v). Although this section may be interpreted to include EAS, the definition of "substance" could be redefined to include, explicitly, EAS as a form of environmental contamination, and then provisions could be developed under this Act for prevention and control of EAS.

Aquaculture

The *Aquaculture Act* (1991 c. 36, as amended) includes sections (s. 8(1,2)) that pertain to prohibitions for the introduction, transfer, or transport of live aquatic animals within, or into, the province (Donihee and Netherwood 2001). Sections 8(3,4,5) of this Act require that an Environmental Impact Assessment be performed to determine the risk of an introduction or transfer of a species or strain of aquatic plants or animals not present naturally in the areas of introduction (Donihee and Netherwood 2001). These provisions limit the risk of new introductions of EAS into the province, but also reduce the likelihood of spreading EAS within the province. However, provisions for action in the event of an escape of a species are not provided in this Act.

Fish sales/fish markets

Section 9 of the *Fish Inspection Regulations* (O.C. 96-934) prohibits the sale of live clams, mussels or other molluscs except in the specific circumstances outlined. This restriction decreases the likelihood of introducing exotic molluscs via fish markets. However, the regulations would be more effective if prohibitions were included to address the sale of exotic fish in fish markets. Licensing requirements for marketing fish are also outlined in Section 31.

Baitfish

Section 9 of the *Wildlife Regulations* (Reg. 1156/96) states that a person cannot buy, sell, or use for a commercial purpose any fish, other than smelt and eels taken in inland waters.

Aquarium pet trade

No specific legislation is present.

Nova Scotia

General statutes and regulations

Sections 63 and 64 of the *Wildlife Act* (R.S., c. 504, s. 2) prohibit the import and export of live or exotic wildlife (Donihee and Netherwood 2001). Additionally, Section 62(1) prohibits the keeping of exotic wildlife, except as provided by this Act, regulations pursuant to the Act, or any other enacted legislation.

Pertinent sections of the *Fisheries and Coastal Resources Act* (1996, c. 25, s. 1) relating to prohibitions and permits for the introduction of foreign species of aquatic plants or animals have been identified in Donihee and Netherwood (2001).

Sections 6(1)a,b,c,d,e,f) of the *General Wildlife Regulations* (*Wildlife Act* N.S. Reg. 205/87, as amended) relating to permits for holding in captivity of native or exotic wildlife were identified by Donihee and Netherwood (2001). The definition of "exotic wildlife" is "all birds, mammals, and other vertebrates that are not indigenous to the province and that in their natural habitat are wild in nature" (s. 1). Because the definition of "exotic wildlife" is narrow and includes only vertebrates, the ability of the province to control and manage the unintentional introduction and spread of EAS is severely limited and can only be applied to exotic species of fish and not invertebrates.

Aquaculture

The *Fisheries and Coastal Resources Act* (1996, c. 25, s. 1) states that an aquaculture license is required to carry on aquacultural practises (s. 44(1)). Under this Act, it is prohibited

to introduce a species of aquacultural plants or animals foreign to the area without first obtaining an aquacultural license (s. 54(1)). Section 64(1) of this Act states that the Governor in Council may make regulations with respect to the introduction of new species or strains of aquatic plants or animals. This section could be used to control and manage EAS if it were amended to specifically address exotic species of fish, including a list of prohibited species for aquaculture, and preventative measures relating to the escape of species of fish.

Fish sales/fish markets

Section 73 of the *Fisheries and Coastal Resources Act* (1996, c. 25, s. 1) states that a license from the Minister is required to buy, sell, possess or market fish. However, no list of restricted or prohibited species is provided. Therefore, no restrictions are present in the Act to prevent the sale of exotic species of fish in fish markets.

Baitfish

Section 18 of the *Maritime Provinces Fishery Regulations* (SOR 193-55) outlines restrictions for bait use, including prohibiting the use of live fish for bait that have been imported from other provinces.

Aquarium pet trade

Section 61(3) of the *Wildlife Act* (R.S., c. 504, s. 2) requires a permit for the release of exotic wildlife from captivity. This section could apply to the aquarium pet trade to prohibit the garden release of pets, without first obtaining a permit to do so.

Prince Edward Island

General statutes and regulations

The *Wildlife Conservation Act* (c. W-4.1) states that regulations may be made by the Lieutenant Governor "regarding the export, import, transfer, and sale of wildlife" (s. 28(f)) and for "regulating the possession and release of exotic wildlife" (s. 28(x)). The definition of "wildlife" is very broad, and includes "wild mammals, birds, reptiles, amphibians, fish, invertebrates, plants, fungi, bacteria, and other wild organisms as prescribed by the regulations" (s. 1(jj)). Therefore, this province has some capability to control and manage EAS, but this is limited because the development of regulations are under the discretionary power of the Lieutenant Governor. Provisions under this Act could be strengthened if the word "may" were replaced by "must" thereby obliging the province to develop regulations for the import, export, transfer, and sale of wildlife, and the possession and release of exotic wildlife.

The *Fish and Game Protection Act*[1] - General Regulations[2] *(Wildlife Conservation Act)* (EC818/66) includes pertinent sections that deal with prohibitions and permits for the import, export, possession, and release or exotic animals (s. 5, 6, 7, 8, 9.1(1,2), 9.2) (Donihee and Netherwood 2001). The definition of "exotic" means "a species that is not indigenous to the province and that in its natural habitat is usually found wild in nature" (s. 1).

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[1]*The Fish and Game Protection Act*, R.S.P.E.I., CP. F-12 is repealed.

[2]Pursuant to clause 34(1)(e) of the *Interpretation Act*, R.S.P.E.I. 1988, Cap 1-8, the regulations made under the repealed Act are deemed to be made under this Act and remain in force until revoked or others are made in their stead (1998 c. 107, s. 33).

Aquaculture

The *Fisheries Act* (c. F-13.01) states the Minister may, with the approval of the Lieutenant Governor in Council make regulations including the collection of information, records and reports from aquaculturists (s. 7a), and licensing of aquaculturists (s. 7b). Licensing requirements including the restriction of invasive exotic fish for aquaculture could be included. Additionally measures to prevent the escape of aquacultural produce, and recapture plans should be identified. These two additions would strengthen the power of this Act to control and manage EAS.

Fish sales/fish markets

The *Wildlife Conservation Act* (W-4.1) states that regulations may be made by the Lieutenant Governor "regarding the export, import, transfer, and sale of wildlife" (s. 28(f)). The definition of "wildlife" is broad, and includes wild fish (s. 1(jj)). Therefore regulations made pursuant to this section would include the sale of fish whether at fish markets or in other settings.

Baitfish

Section 18 of the *Maritime Provinces Fishery Regulations* (SOR 193-55) outlines restrictions for bait use, including prohibiting the use of live fish for bait that have been imported from other provinces.

Aquarium pet trade

The *Wildlife Conservation Act* (c. W-4.1) states that regulations may be made by the Lieutenant Governor "regulating the possession and release of exotic wildlife" (s. 28(x)). Therefore, regulations made pursuant to this section could apply to garden releases of fish or other EAS acquired through the aquarium pet trade.

New Brunswick

General statutes and regulations

All sections of the *Fish and Wildlife Act* (F-14.1) that apply to EAS control and management have been identified in Donihee and Netherwood (2001). Sections 38.1 (1a,b,c,d) of this Act are noteworthy because they deal specifically with the import and export of exotic wildlife. The definition of "exotic wildlife" is limited to vertebrates, so the ability of the province to control and manage the unintentional introduction and spread of EAS is limited to exotic fish. However, a redefinition of the term "wildlife" to include exotic invertebrate species, could allow this Act to authorize management of EAS in its jurisdiction.

Exotic Wildlife Regulation (Reg. 92-74) includes a list of species and subspecies of exotic wildlife that were excluded from Section 38.1(1a,b) of the *Fish and Wildlife Act* (Donihee and Netherwood 2001).

Aquaculture

The *Aquaculture Act* (c. A-9.2) includes Sections 16(1,2) that specify the species and strains of aquatic plants and animals to be cultivated, and prohibits the cultivation of others (Donihee and Netherwood 2001). Section 11(1d) requires that measures be taken to prevent the escape of aquacultural produce. By providing restrictions on the cultivation of certain species, the probability of invasive EAS being cultivated in aquaculture is limited.

Additionally, the development of measures to prevent the escape of aquacultural produce decreases the chance of species being introduced into natural waterways.

The *General Regulations* (Reg. 91-158) have no provisions specifically for the control and management of EAS.

Fish sales/fish markets

Section 4 of the *Fish Inspection Act* (c. F-18) states that a license is required to operate or maintain an establishment. In the Act, "establishment" is defined as "any place where fish are processed for sale, stored for sale or offered for sale and includes retail and wholesale sales outlets." Although fish markets are not specifically addressed in this Act, the definition of "establishment" is broad, and may be interpreted to include fish markets.

Regulations (Reg. 84-24) state that anyone who purchases or collects fish for resale must obtain a fish buyer's license (s. 14(1)). No prohibitions are present for the types of fish species that may be sold. Therefore, there are no restrictions in these Regulations regarding the sale of exotic fish species in fish markets.

Baitfish

Section 18 of the *Maritime Provinces Fishery Regulations* (SOR 193-55) outlines restrictions for bait use, including prohibiting the use of live fish for bait that have been imported from other provinces. No live fish may be possessed or used as bait in inland waters (s. 19(1)). Live fish may be used as bait only if taken from the body of water in which it will be used and is not a species restricted under Section 18(a).

Aquarium pet trade

No specific legislation is present.

Quebec

General statutes and regulations

An *Act Respecting the Conservation and Development of Wildlife* (R.S.Q. c. C-61.1) includes pertinent sections that could be used for EAS control and management (s. 69, 70, 71(1-3), 72, 73(1-7), 78(1-3)). These sections refer specifically to prohibitions and conditions for the sale, purchase, possession, and keeping of animals (Donihee and Netherwood 2001). The term "animal" includes "any mammal, bird, amphibian or reptile of any genus, species or subspecies propagating naturally in the wild in Québec or elsewhere from indigenous stock, or not easily distinguishable from wild species by its size, color or shape, whether or not it is born or kept in captivity; this term also applies, wherever permitted by the context, to any part or to the flesh of such an animal" (s. 1). This definition restricts coverage to vertebrates and limits the application of the Act to prevent and manage invertebrate EAS. If the Act were amended to apply to exotic invertebrate species, and also to the unintentional release of species, it could be used to support provincial management of EAS.

Aquaculture

The *Regulation Respecting Aquaculture and the Sale of Fish* (R.R.Q. c. C-61.1, r. 0.0002) includes Sections 2, 4, 26, 27(1,2,3) 30(1-21), 31(1,2,3) that apply to the production, stocking, holding, breeding and transport, purchase, sale, and importation of fish (Donihee and Netherwood 2001). The Regulation does not apply to hobby fish, including goldfish

(*Carassius auratus*) (s. 2). Importation is defined as "the introduction into Quebec of live fish from a Canadian province or territory, or from another country" (s. 26). Therefore, importation regulations could be used to protect against the unintentional introduction and spread of EAS.

Fish sales/fish markets

An *Act Respecting the Conservation and Development of Wildlife* (R.S.Q. c. C-61.1) includes Section 70 that prohibits the sale or purchase of fish that are prohibited by regulation. This section also states that "the Government may, by regulation, authorize the sale of any class of fish of a species contemplated in the first paragraph according to such norms and conditions as it may determine." Therefore, this does not cover all exotic fish, only those listed as prohibited under the regulations.

The *Regulation Respecting Aquaculture and the Sale of Fish* (R.R.Q. c. C-61.1, r. 0.002)(O.C. 1302-94) includes sections relating to restrictions on the sale of live fish and license requirements (Alexander 2003).

Baitfish

The *Regulation Respecting Aquaculture and the Sale of Fish* (R.R.Q. c. C-61.1, r. 0.002)(O.C. 1302-94) includes sections relating to the sale of baitfish and licensing requirements (Alexander 2003).

Aquarium pet trade

The *Regulation Respecting Aquaculture and the Sale of Fish* (R.R.Q. c. C-61.1, r. 0.002)(O.C. 1302-94) has an important loophole relating to non-native hobby fish, which are exempt from regulations that prohibit the transportation and holding of non-native fish (s. 2) (Alexander 2003). This could be problematic because "hobby fish" are undefined, therefore, there are no regulations to prevent invasive exotic fish from being introduced.

Ontario

General statutes and regulations

The *Fish and Wildlife Conservation Act* (S.O. 1997 c. 41) includes pertinent sections relating to licensing and the import, export, transportation, possession, and release of fish, wildlife, and invertebrates in Ontario (Donihee and Netherwood 2001). Most of these sections do not apply directly to EAS, but could be used to regulate, indirectly, EAS releases from aquaculture, fish sales/fish markets, and the aquarium pet trade industry.

The *Environmental Protection Act* (R.S.O. 1990 c. E. 19) includes Section 6(1) that prohibits the discharge of any contaminant into the natural environment. It states that the contaminant cannot be "in an amount, concentration or level in excess of that prescribed by the regulations." Due to the specific wording used, the Act is likely referring to chemical contaminants, hence the mention of a base level, or concentration. However, this section could be amended by re-defining EAS as biological contaminants, and then provisions for prevention and control of EAS could be developed.

Aquaculture

The *Fish Licensing Regulations* (O. Reg. 664/98) include sections concerning approved and unlisted species for aquaculture, licensing requirements, and approved and mandatory practices for license holders (Alexander 2003). All applicants for an aquaculture license must provide a description of measures to prevent the escape of fish.

Fish sales/fish markets

The *Fish Licensing Regulations* (O. Reg. 664/98) include sections concerning the buying and selling of fish either found or cultured (Alexander 2003). Because the food fish market is largely unregulated, there is potential for release of EAS through this vector.

Baitfish

Alexander (2003) summarized pertinent sections of the *Fish Licensing Regulations* (O. Reg. 664/98) related to baitfish license requirements, mandatory practices, and prohibitions. The use of live bait fish is prohibited in certain waters, and recent amendments to the Regulations prohibit the use of round goby (*Neogobius melanostomus*) and tubenose goby (*Proterorhinus marmoratus*) for bait purposes.

Aquarium pet trade

Section 24 of the *Fish Licensing Regulations* (O. Reg. 664/98) states that an aquaculture license is not required for fish cultured in an aquarium (Alexander 2003). Because a license is not required to culture fish for personal use or the aquarium trade, exotic fish may be sold in the pet or hobby market. This is an important loophole because it may result in garden releases of exotic pet/hobby fish. Recent amendments to the *Fish Licensing Regulations* (O. Reg. 664/98) help to close this loophole by prohibiting the sale of black carp (*Mylopharyngodon piceus*), bighead and silver carp (*Hypophthalmichthys nobilis* and *H. molitirx*), and grass carp (*Cteopharyngodon argus*), all species of snakehead (*Channa* spp., and two species of goby (round and tubenose) for aquarium use. Pet shops with these species are required to dispose of them.

British Columbia

General statutes and regulations

The *Fisheries Act Regulations* (includes amendments up to B.C. Reg. 109/2002) have sections that could be applied to EAS control and management (Donihee and Netherwood 2001). These Regulations deal mainly with control of oyster culturing. Section 11 states that "the area known as Pendrell Sound, Redond Island, New Westminster, is reserved from alienation to protect the culture of oysters, oyster seed production and to preserve the ecological integrity of the area." EAS could disrupt the ecological integrity of the area by becoming competitors of the native oyster species. This Regulation could be used to control and manage against EAS under the premise that EAS could disrupt the ecological integrity of an area that they invade.

Section 21 of the *Wildlife Act* (RSBC 1996 c. 488) prohibits the import and export of wildlife without a permit issued under that Act, or the Convention on International Trade in Endangered Species (Donihee and Netherwood 2001). The definition of "wildlife" in the Act "means raptors, threatened species, endangered species, game or other species of vertebrates prescribed as wildlife and, for the purposes of Sections 3 to 5, 7, 8 and 108(2v), includes fish" (s. 1). Provisions are present to regulate the import and export of wildlife, and thus the unintentional movement of EAS into and out of the province is minimized.

Aquaculture

Section 13(5) of the *Fisheries Act* (RSBC 1996 c. 149) states that a license is required to carry out aquaculture.

The *Aquaculture Regulation* (B.C. Reg 78/2002[3], O.C. 283/2002) states that the release of aquatic plants or fish from an aquaculture facility to fresh or tidal waters is prohibited unless authorized by an aquaculture license (s. 3(1)). Reasonable precautions must be taken to prevent the escape of aquatic plants and fish, and measures to remedy and confine the *effects* of an escape must be taken (s. 3(2), (3)). Additionally, precautions must be taken when transporting aquatic plants or fish on, over, or through fresh or tidal waters (s. 11(1)). However, no provisions apply to the actual fish that have escaped.

Fish sales/fish markets

The *Fisheries Act* (RSBC 1996 c. 149), states that a person cannot operate a fish buying station unless they hold a license specified for that purpose (s. 13(2)). Licensing requirements to sell fish are outlined in section 13(4).

Section 10(1) of the *Fish Inspection Act* (RSBC 1996 c. 148) refers to the regulatory powers of the Lieutenant Governor in Council with respect to marketing of fish locally. EAS are not mentioned specifically in this Act, but, if s. 10(1) were amended to include regulatory authority for the Lieutenant Governor in Council, then this section could be used to prevent the introduction of EAS via fish sales and markets.

Baitfish

The *British Columbia Sport Fishing Regulation* (SOR/96-137) includes restrictions for bait use but their applicability to EAS control is very minimal. Section 61 states that freshwater invertebrates are prohibited from being used as bait in lakes. This could reduce the likelihood of introducing exotic invertebrates into lakes. However, no provisions are included specifically for the control and management of exotic fish through baitfish use.

Aquarium pet trade

No specific legislation is present.

U.S. State General Statutes and Regulations for Aquaculture, Fish Sales/Fish Markets, Baitfish, and Aquarium Pet Trade

The majority of the states included in this analysis have specific legislation for each of the secondary vectors identified for the introduction and spread of EAS. Therefore, the general statutes and regulations sub-heading is largely excluded from this section of the report.

Maine

General statutes and regulations

An *Act to Prevent Infestation of Invasive Aquatic Plants and to Control Other Invasive Species* (Chapter 434, S.P. 630-L.D. 1812) requires the State task force to recommend an action plan to protect the State's inland waters from infestation by nuisance species and invasive plants (s. 1872). The action plan may include (i) "Identification of inland waters known to be infested"; (ii) a "Lake monitoring program" to monitor inland waters and identify nuisance species and invasive plants; and (iii) a "Rapid Response." These provisions for rapid response to newly-discovered species are unique.

[3]This regulation replaces B.C. Reg. 364/89 O.C. 1624/89 cited in Donihee and Netherwood (2001).

Aquaculture

A person must have a lease issued by the Commissioner to construct or operate aquaculture facilities in the coastal waters of Maine (s. 6072-1-A, 12 *Maine Revised Statute* 665-2).

Fish sales/fish markets

The purchase or sale of black bass (*Micropterus salmoides*), landlocked salmon, pickerel, trout or white perch (*Morone americana*) is prohibited (s. 7615, 12 *Maine Revised Statute* 711-3).

Baitfish

A live bait retailer's license or a baitfish wholesaler's license issued by the Commissioner is required to deal in live bait (s. 7171-1 and 7171-2, *Maine Revised Statute* 10-5). Restrictions on the selling of baitfish under a live bait retailer's license and a bait wholesaler's license are listed in sections 7171-4-A and 7171-4-B.

It is prohibited to sell, offer for sale, use or possess for use as bait any species of fish other than baitfish defined in s. 100001(6) and s. 12553 (12 *Maine Revised Statute* 923-3).

Aquarium pet trade

A permit is required to introduce, import or transport live fish into the state (s. 12509, 12 *Maine Revised Statute* 923-3).

The Commissioner may adopt rules allowing possession and importation of certain species of tropical fish and goldfish without a permit, but only for aquarium purposes (12 *Maine Revised Statute* 707-6). This applies only if the Commissioner determines that the species of fish does not pose an unreasonable risk to any species of fish or organism (s. 7202). This is a loophole in the regulations because such species of tropical fish and goldfish that are allowed to be bought and sold in the aquarium pet trade industry could be released into State waters.

New York

Aquaculture

Alexander (2003) identified requirements and criteria for the operation of marine hatcheries (*New York Environmental Conservation Law* (NYECL 13-316, 13-0316), and 6 *New York Rules and Regulations* (6 NYRR 48.1, 48.6)). The Department may make regulations with respect to trafficking in products of a marine hatchery, but as Alexander (2003) noted, there is no specific reference to the operation of hatcheries. Licensed production on farm fish ponds, hatchery permit requirements, and fishing preserve licenses are dealt with under NYECL 11-1911 and 13-0316, 11-1909, and 11-1913, respectively (Alexander 2003).

Fish sales/fish markets

6 NYRR 48.5 includes restrictions and requirements for the sale of fish raised in a marine hatchery, and requirements for record keeping of "food fish" by seafood wholesalers and retailers.

NYECL 11-13.9 lists fish species from state waters that are prohibited from sale.

Baitfish

NYECL 11-13.5 includes licensing requirements for the taking and sale of specified species for bait. Species that are prohibited for bait are also identified.

Alexander (2003) noted that under the discretion of the Department of Environmental Conservation, the use of baitfish may be prohibited in certain waters (*NYECL* 1316).

Aquarium pet trade

No specific legislation is present.

Pennsylvania

Aquaculture

58 *Pennsylvania Code* 71.2 includes an annually-updated list of species approved for stocking and aquaculture, provided by the Bureau of Fisheries. Alexander (2003) noted that only those species approved may be cultivated without using a "closed system". Restricting the species that may be cultivated in an "open system" reduces the chance of introducing and spreading potentially harmful EAS. 58 *Pennsylvania Code* 71.3 includes the definition of a closed system (Alexander 2003).

3 *Pennsylvania Consolidated Statute* 4219 includes species not on the aquaculture approved list that may be cultivated in a closed system.

Alexander (2003) identified registration requirements for aquaculturists, and summarized the actions that are allowed and prohibited for registrants (3 *Pennsylvania Consolidated Statute* 4220).

Fish sales/fish markets

Permission from the Commissioner is required to sell fish or fish eggs taken from Pennsylvania waters (58 *Pennsylvania Administrative Code* 63.42). Exceptions to this are provided in Alexander (2003).

Requirements to register as a dealer in live aquatic species and species that may be distributed are in 3 *Pennsylvania Consolidated Statute* 4221 and 30 *Pennsylvania Consolidated Statute* 2507. Alexander (2003) noted that only those species of fish approved by the department (same list as for stocking and aquaculture) may be distributed, and records must be kept. This is an important restriction because potentially harmful exotic species of fish are not on the department approved list, and thus the risk of introducing exotic fish through the fish market may be reduced.

Baitfish

58 *Pennsylvania Administrative Code* 63.44 includes species that may not be used or possessed for bait purposes.

Aquarium pet trade

Alexander (2003) noted that permission is not required for the importation of tropical fish unless they are considered by the Commissioner to be dangerous or will negatively impact native fish populations (58 *Pennsylvania Administrative Code* 73.1). This may provide a loophole because many exotic species are not tropical, and it is under the discretion of the Commissioner as to whether the tropical fish will be dangerous to native fish populations. Therefore, there is minimal to no restriction to prevent EAS from this source.

Pet shops are exempt from prohibitions on sale of fish as long as such fish are not taken

from state waters (30 *Pennsylvania Consolidated Statute* 2507).

Ohio

Aquaculture

Ohio Administrative Code 1501: 31-1-02(AAAA) and 1501: 31-1-02(BBBB) include the types of aquaculture permits required for different types of fish farming, and the waters in which aquaculture may take place. Restrictions for Class B permits (potentially invasive types of fish) are also provided. Alexander (2003) noted that species listed as "unclassified" may not be maintained for aquaculture purposes. Regulations for Class B permits are outlined in *Ohio Revised Code* Ann. 1533.632.

Uses of water for aquaculture, other than those under private control, are prohibited without permission of the Division of Wildlife (*Ohio Revised Code* Ann. 1501:31-39-01).

Fish sales/fish markets

Ohio Revised Code Ann. 1533.631 includes permit requirements for wholesale fish markets.

Baitfish

Ohio Revised Code Ann. 1533.40 includes permit requirements for minnow dealers, and possession restrictions for baitfish.

Prohibited species for sale, or use as bait, are listed in *Ohio Administrative Code* 1501:31-13-04.

Aquarium pet trade

No specific legislation is present.

Michigan

Aquaculture

The *Michigan Aquaculture Development Act* (1996) includes pertinent sections that may be applied to EAS control (Alexander 2003). These include a list of approved species (s. 286.875), registration, preventative measures for the escape of species (s. 286.877), and requirements for a research permit (s. 286.878). Exemptions from the aquaculture laws are also listed (s. 286.876).

Fish sales/fish markets

No specific legislation is present.

Baitfish

Importation and exportation restrictions for minnows, wigglers (i.e. earthworms), and crayfish (MCLS 324.48729, *Natural Resources and Environmental Protection Act* 1994) are identified in Alexander (2003).

Aquarium pet trade

Alexander (2003) reported that retail ornamental fish facilities are exempt from aquaculture laws (MCLS 286.876 *Michigan Aquaculture Development Act* 1996). The escape of ornamental fish from ponds is possible under this exemption. However, the aquarium pet trade must still abide by the State's prohibited species ban.

Illinois

Aquaculture

The *Fish and Aquatic Life Code* [515 ILCS 5/] states that it is unlawful to release any aquatic life into State waters without government permission (s. 1-100 from Ch. 56, par. 10-100). The government also has the authority to develop and enforce regulations under the *Illinois Administrative Procedure Act* to regulate possession, transportation and shipping of aquatic life not indigenous to the State (s. 1-100 from Ch. 56, par. 10-100). This Code applies generally to aquaculture, and is important because by prohibiting the unauthorized release of aquatic life, the risk of new introductions of EAS is reduced. Moreover, the likelihood of new EAS spreading and becoming established in the Great Lakes or their tributaries is decreased.

Fish sales/fish markets

Sections 20-70 of the *Fish and Aquatic Life Code* [515 ILCS 5/] state that any person buying, selling, or shipping aquatic life, conducting a fish market, or selling live fish for stocking must obtain a fish dealer's license (Alexander (2003). Exemptions and conditions under which the licenses are valid are also listed. However, no provisions are present for the management of escapees.

Section 805.40(a)(17 *Illinois Administrative Code* 805) states that species listed as injurious may not be possessed for food markets (Alexander 2003). The State also has developed a list of injurious species.

Baitfish

Sections 20-80 of the *Fish and Aquatic Life Code* [515 ILCS 5/] that apply to baitfish have been identified in Alexander (2003). Section 810.50 (17 *Illinois Administrative Code* 810) deals with the catch and use of live minnows by sport anglers.

Aquarium pet trade

The *Fish and Aquatic Life Code* [515 ILCS 5/] prohibits the release of any aquatic life into State waters without permission from the department (s. 1-100 from Ch. 56, par. 10-100). However, the owner of a body of water may release aquatic life that is indigenous to the State into waters that are entirely on his/her property (s. 1-100 from Ch. 56, par. 10-100). This section could regulate garden releases of aquatic life acquired through the aquarium pet trade. However, some individuals may not know if the aquatic life being released is indigenous or not. Therefore, allowing the release of indigenous aquatic life into the waters that are wholly on one's property may cause accidental release of EAS.

Indiana

Aquaculture

Requirements for aquaculture permits and restrictions under permits (s. 17, 312 *Indiana Administrative Code* 9-10) have been identified in Alexander (2003).

Fish sales/fish markets

Permit requirements for the sale of fish (s. 14, 312 *Indiana Administrative Code* 9-10), including triploid grass carp (s. 17, 312 *Indiana Administrative Code* 9-10), and criteria for the sale of "hatchery-reared fish" are cited in Alexander (2003).

Baitfish

Requirements for a baitfish dealers license and possession permits are contained in s. 1 of *Indiana Statute* Ann. 14-22-6 (Alexander 2003).

Aquarium pet trade

Pet trade is defined as "the business of importing, producing, or selling live fish for display in aquariums, tanks, or other continuing exhibits" (s. 1, *Indiana Administrative Code* 9-6, s. 15, *Indiana Administrative Code* 9-10). Alexander (2003) identified an important loophole in that the aquarium pet trade is exempt from import, sale, and aquaculture permitting requirements. However, it is not exempt from the State's list of prohibited species.

Wisconsin

Aquaculture

Wisconsin Statutes 95 and 29 include requirements to operate fish farms, including permit, certificate, and registration requirements (*Wisconsin Statute* 95.001, 95.60). Fish farming permits in natural waters will be issued only if the public has no access to them, the body of water is self contained and freezes at least twice yearly and is unable to sustain a population of fish (*Wisconsin Statute* 29.733, 29.001). Facilities existing prior to 1998 are grandfathered out of this requirement (*Wisconsin Statute* 29.733, 29.001). These restrictions decrease the likelihood of EAS, especially fish species, from being introduced. The "self contained body of water" restriction minimizes the risk of spreading exotic fish species to other areas. Alexander (2003) pointed out that under *Wisconsin Statute* 29.734, all fish farms must have barriers that prevent the escape of fish into the waters of the State. This important requirement also applies to grandfathered facilities.

Non-native fish species determined by the Department of Natural Resources to pose a risk to State waters may not be introduced or propagated (*Wisconsin Administrative Code* NR 16.74).

Fish sales/fish markets

Wisconsin Statute 29 includes requirements for a wholesale fish dealer's license and for selling fish under the license (*Wisconsin Statute* 29.503). Prohibitions on the sale of fish caught in "private fishing preserves" (*Wisconsin Statute* 29.503) are also included. However, requirements for the sale of fish under a fish dealer's license apply mostly to labeling, identification information, and records of sales. No regulations are present restricting the species imported for fish sales, except for trade in lake sturgeon (*Acipenser fulvescens*).

Baitfish

Wisconsin Statute 29 includes requirements for a bait dealer's license and restrictions for licenses (*Wisconsin Statute* 29.503). It is important to note that a stocking permit must be issued in order to release unused bait into the waters of the State. Stocking permits restrict the types of species that may be imported, which decreases the likelihood of introducing exotic fish into the State waters.

Aquarium pet trade

Although a Department of Natural Resources permit is required for "rough fish" imported

for the pet trade (*Wisconsin Administrative Code* ATCP 11.58, *Wisconsin Statute* 29.407), the aquarium pet trade is largely unregulated Alexander (2003). This is because both "ornamental fish", and any fish "that will be held for the remainder of their lives, in fully enclosed buildings solely for the purposes of display and research" are fully exempt from importation permits (*Wisconsin Administrative Code* ATCP 11.58, *Wisconsin Statute* 29.407). Therefore, minimal to no regulations exist to restrict the sale of fish. Moreover, the risk of introductions of exotic fish through garden releases is substantial.

Minnesota

General statutes and regulations

A statewide program is required to prevent and control the spread of detrimental exotic species (s. 84D.02, *Minnesota Statute* 84D). The program must provide coordination among the government and private land owners, and federal funding should be provided to support the program (s. 84D.02).

Aquaculture

Minnesota Statute 17.4984 includes licensing requirements to operate an aquatic farm and private fish hatchery (Alexander 2003).

Alexander (2003) identified section 6216.0500 (*Minnesota Rule* 6216) in the regulations that applies to EAS control and management in aquaculture, and stated that natural lakes or wetlands infested with exotic species are not approved for aquaculture. This regulation helps prevent the spread of exotic species that are already established to other water bodies.

Fish sales/fish markets

Section 97C.341 (*Minnesota Statute* 97C) outlines the restrictions for the sale of fish, and includes licensing requirements.

Baitfish

Section 6216.0400 (*Minnesota Rule* 6216) includes permit requirements for bait harvest (s. 6216.0400).

Section 97C.341 (*Minnesota Statute* 97C) includes lists of fish that may not be used for bait.

Aquarium pet trade

Section 84D.09(a) (*Minnesota Statute* 84D) states that if a person allows or causes the introduction of a prohibited, regulated, or unlisted exotic species, they must notify the appropriate government authority within two days, and make every attempt to recapture or destroy the introduced animal. The person is also responsible for the costs incurred by the government in capturing or controlling the exotic species (s. 84D.08(a). This section therefore may be used to regulate the garden release of EAS acquired through the aquarium pet trade.

As noted by Alexander (2003), aquarium pet trade fish are largely categorized as "unregulated" including "subtropical, tropical, and salt water fish, except anadromous species" (s. 6216.0270, *Minnesota Rule* 6216). However, as a whole, aquarium pet trade fish are not exempt from the harmful exotic species laws.

Washington

General statutes and regulations - Aquatic nuisance species

The *Washington Administrative Code (WAC)* 12-01701 includes species designated as deleterious exotic wildlife and aquatic nuisance species (s. 1(a,b,c)). The intentional import or possession of aquatic nuisance species (ANS) into the State is prohibited, except as provided in this section (s. 2). All ANS are required to be confined to a secure facility to prevent the escape, release, or transport of such species or their larvae (s. 4(a)).

Aquaculture

Section 77.125.030 of the *Revised Code of Washington* (WRC) states that rules for marine fin fish aquaculture must be developed by the director in cooperation with aquaculture farmers. These rules include provisions for the prevention of escapes of cultured marine fin fish (WRC 77.125.030(1)), and provisions for management plans to facilitate a rapid capture of escapees (WRC 77.125.030(12)).

The *WAC* includes identification requirements for aquatic farmers for the sale or movement of listed aquatic products (WAC 16-603-010). Every aquatic farmer who cultivates aquatic products must be registered with the department (WAC 220-76-010). Applicants for a fin fish aquaculture permit must provide a fish escape prevention and recapture plan, and approval of the plan is required before a permit is issued (WAC 220-76-110).

Fish sales/fish markets

A license issued by the director is required to deliver food fish or shellfish taken in inshore waters (RCW 77.65.010(1b)), and to engage in processing of wholesale food fish or shellfish (RCW 77.65.010(1d)).

Baitfish

The possession or use of live fish for bait while fishing for game fish is prohibited (WAC 232-12-144).

Aquarium pet trade

No specific legislation is present.

CANADIAN EMERGENCY ACTION LEGISLATION

Many government agencies have contingency programs that will allow designated parties to deal rapidly with emergency situations that represent threats to health, safety and property. Deployment can include taking preventative action to minimize damage, or deal with its consequences in an expedient manner. Authority to act and to devise emergency plans, including options, interagency cooperation, and access to resources, are essential elements for this rapid response capability.

Federal Statutes and Regulations

Section 4 of the *Emergency Preparedness Act* (R.S., 1985, c. 6 (4th Supp.)) states that "the Minister is responsible for advancing civil preparedness in Canada for emergencies of all types..." and is responsible for developing and implementing emergency plans in

cooperation with provincial and foreign governments. Due to the vagueness of this statement, the responsibilities of the Minister could be interpreted to include preparedness for environmental emergencies. If this Act were amended to include, explicitly, environmental damage as a form of emergency, then provisions for developing and implementing management plans that address a fast action response to newly discovered EAS, may be developed.

Provincial Statutes and Regulations

Newfoundland and Labrador

The *Emergency Measures Act* (1990, c. E-8) defines emergency measures as, "the planning, organization, establishment and operation of defensive, precautionary and safety measures, controls, facilities and services of all kinds...necessary or desirable in the public interest for meeting, reducing, preventing and overcoming the effects of civil disaster or a war emergency..." (s. 2(f)). The environment is not addressed in the Act, and therefore, it cannot be used for invasive species control.

Nova Scotia

The *Emergency Measures Act* (1990, c. 8) defines an emergency as "a present or imminent event in respect of which the Minister or municipality, as the case may be, believes prompt co-ordination of action or regulation of persons must be undertaken to protect property or the health, safety or welfare of the people of the province" (s. 2(b)). In its present form, the Act cannot be used to address EAS control because the emphasis is on the human population and not on the environment.

Prince Edward Island

The *Emergency Measures Act* (1990, c. 11) defines emergency as " a present or imminent event in respect of which the Minister or municipality believes prompt co-ordination of action or special regulation of persons or property must be undertaken to protect the health, safety or welfare of the people or to limit damage to property" (s. 1(c)). Damage to the environment is not included in the definition, therefore the Act cannot be used to address EAS.

New Brunswick

The *Emergency Measures Act* (1978 c. E-7.1) definition of emergency is "a present or imminent event in respect of which the Minister or municipality, as the case may be, believes prompt coordination of action must be undertaken to protect property, the environment or the health, safety or welfare of the civil population" (s. 1). The emphasis on the human population precludes this Act's application to the control of EAS in that province.

Quebec

The *Civil Protection Act* (R.S.Q. S-2.3) provides the authority to declare a state of emergency in the case of disasters, and to develop and implement emergency preparedness measures for such disasters. However, both "major" and "minor" disasters are defined in the Act mainly in relation to harm caused to persons or property caused by certain types of events. These definitions do not address harm caused to the environment, and therefore, provisions under the Act cannot be used to address EAS.

Ontario

Emergency Management Act (R.S.O. 1990, c. E.9) definition of emergency is; "a situation caused by the forces of nature, and accident, an intentional act or otherwise that constitutes a danger of major proportions to life or property" (s. 1). This definition of emergency does not include damage to the environment, therefore it cannot be applied to develop a fast action response to newly discovered EAS.

British Columbia

Section 4(1) of the *Emergency Program Act* (RSBC 1996 c. 111) states that the minister must develop emergency plans to prepare for, deal with, and recover from emergencies or disasters. However, the definitions of "emergency" and "disaster" in the Act do not include environmental damage as the cause of emergencies or disasters, thus this Act in its present form, cannot be used to address invasive species control.

RAPID RESPONSE CAPABILITY FOR EXOTIC SPECIES

A decision on how to deal with an introduced species is usually difficult for many regional authorities largely due to the lack of protocols. A common response for many species not known to be invasive is no action, other than monitoring its distribution. Decisions on species known to present a risk will be inherently more complex because proactive action may be considered, and various parties may not agree with the level of intervention, or even that one is needed. The latter has become an issue in the U.S. where a decision to act has been delayed by opponents through legal interventions.

The most effective way to manage EAS is to reduce the risk of introduction, and reduce the probability of becoming well established and widely distributed. Efforts to reduce ballast water related introductions include moving towards mandatory global ballast water exchange regulations, and development of ballast water treatment technology that can remove or reduce the viability of organisms on board. Efforts to curtail other means of introducing EAS have generally been less successful because current regulations may not be well suited for that purpose. Prevention of species' establishment and spread is critical because, it is usually difficult to eradicate EAS once they have become established (Harty 1993, Marsden 1993). Case histories have shown that economic costs associated with the management of EAS far exceed those of prevention. Therefore, given the likelihood that EAS will continue to be introduced to Canadian fresh and salt waters, the creation of a comprehensive action plan to deal with EAS on a national basis is critical.

The need to detect and respond to new EAS has been identified in soft laws such as policies and management plans of both Canada and the U.S., at both the federal and provincial/state levels (National Invasive Species Council 2001, National Workshop on Alien Invasive Species 2001). "Soft laws", such as management strategies or agreements, refer to regulatory conduct but are not legally binding (Lyster 1985). The enactment of enabling legislation, specifically for a rapid response to EAS, has largely not been established in either Canada or the U.S. Although early detection and rapid response have been identified as important components of exotic species management, there are no comprehensive systems in place in either Canada or the U.S. (jurisdictions examined in this report) for detecting and responding rapidly to new invasions. This may be due to problems with jurisdictional issues,

insufficient resources, and unclear definitions of the roles that government and non-government agencies would play in such a response.

DEVELOPING TOOLS TO MANAGE UNDESIRABLE AQUATIC SPECIES

Use of chemical biocides like rotenone, antimycin, and 3-trifluoromethly-4-nitrophenol (TFM) has been the common method used by North American natural resources agencies to control or eradicate undesirable species (Busiahn 1993, pers. comm., A. Dextrase, Ontario Ministry of Natural Resources, Peterborough, ON). A survey among Canadian and U.S. agencies indicated that 40 of 62 respondents used rotenone within the past 10 years (McClay 2002). Other aquatic biocides in use for many years include 2,4-Dicholo-phenoxyacetic acid (2,4-D) for vegetation, and copper-based compounds for invertebrates. Rotenone is commonly used because of its low cost, and its effectiveness in treating large bodies like the 1,630 hectare Lake Davis, CA, and the 6,950 hectare Strawberry Reservoir, UT (McClay 2000, Lee 2002).

Species identified for treatment can represent a range of taxonomic groups from microbes to vertebrates. While the number of biocides approved for field application use is limited, the piscicides, copper-based molluscides, and 2,4-D based herbicides currently available would be effective on many aquatic vertebrates, invertebrates and vegetation. Chlorine based biocides also can be effective under some conditions.

Chemical biocides are effective in eradicating the target species, however most are non-selective and will affect other species. It is therefore important that a treatment program also include a rehabilitation component to facilitate recovery of the system treated. For example, Minnesota conducted a fish eradication program on Knife Lake that initially contained 52 species: 49 species were re-introduced after the treatment (pers. comm. T. Brastrup, MN Department of Natural Resources). Rehabilitation should also include re-introducing other aquatic fauna and flora as required.

The presence of many species and trophic levels, and the formation of complex biological community relationships is an important defensive mechanism against a species from assuming a dominant position (Elton 1958). There appears to be little or no other treatment option that is as effective as chemicals to control undesirable species in aquatic ecosystems at the present time.

FRAMEWORK FOR MAKING DECISIONS

There were two particularly successful EAS eradications whose actions can provide the framework for future proactive taskforces to follow. This was the case for black striped mussel (*Mytilopsis sallei*) in Australia, and the alga *Caulerpa taxifolia* in the U.S., where both were known to be invasive, and first reported on the continent. The mussel was reported in three harbors between March 27-29, 1999, (Bax 1999, Ferguson 2000). Following international confirmation of the species, the Northern Territory government and other responsible agencies held a special meeting on March 30, and passed regulatory amendments to facilitate the eradication process, established a taskforce, and approved the expenditure of

funds. The harbors were closed for treatment on April 1 using the *Fisheries Act* (1988) and *Quarantine Act* (1908). Following tests, the harbors were treated with chlorine and copper sulfate bewteen April 4-9. Intensive sampling was followed by a 21 day "all clear" report and the harbors were re-opened on May 8.

C. taxifolia was reported on June 12, 2000, in a lagoon near Carlsbad, CA (Anderson 2003, Ferguson 2003). Regulatory agencies met soon after, and agreed on the need for (i) species confirmation, (ii) key agencies to be informed, (iii) information about the species, (iv) expertise on the aquatic plants eradication, (v) a decision to eradicate, (vi) legal restrictions on eradication to be resolved, (vii) field crews to be in place, (viii) funds and other resources be available, and (ix) evaluations of these actions be made. Eradication was difficult because any fragments released were capable of developing into new plants. The colonized areas were isolated by covering the plants with sealed PVC sheets. Liquid chlorine injections began on June 29. A second colony of algae was reported in Huntington Harbor, CA, and similar action was taken. Follow up surveys over several years indicated that both eradications were successful.

Eradication of an exotic polychaete worm in the U.S. can represent a situation where the potential impact of an undesirable species may not be perceived as high as for *M. sallei* and *C. taxifolia*, but a decision was made to eradicate it. The exotic sabellid polychaete *Terebrasabella heterouncinata* was reported at an abalone (*Haliotis sp.*) mariculture facilty in California in 1996 (Culver and Kuris (2000). This was the first reporting of this species in North America in a localized area, and concern was expressed because it can cause shell deformity and greatly reduce growth in abalone. Eradication was successful after two years when 1.6 million turban snails (*Teluga funebralis*) were manually removed from surrounding waters. Disruption of life cycle of this polychaete, that requires the snail as an intermediary host, was the basis for using this selective method of eradication.

FACTORS THAT CAN INFLUENCE DECISIONS

The decision to initiate control or eradication will be site specific and time dependent, and should consider the perceived threat from that exotic species, probability of treatment success, consequences of no action, and actions that delay treatment and remove the option to act. Strong cases can be made for the decision to eradicate *M. sallei* and *C. toxifolia* because of their restricted distribution and first reporting on a continent. *M. sallei* is a close relative of the zebra mussel that invaded the Great Lakes where mean adult densities of 4,100 to 33,200 per square meter were reported over a three year period in Lake Huron (Nalepa et al. 1995). The Mediteranean strain of *C. taxifolia* is a rapidly growing alga that forms a dense cover in shallow waters. The one metre square patch that was reported in 1984 quickly expanded to cover 131 square kilometers by 2000 (Meinesz 2002).

Ruffe (*Gymocephalus cernuus*) is an invasive fish that was first reported in North America in the St. Louis River estuary, at western Lake Superior in 1986. A taskforce was established and decided on a control program, although an eradication option was considered for this benthic species (Busiahn 1993). The species expanded its range along the southern and northern shores of Lake Superior by 1991, and the option to eradicate was lost. In contrast, zebra mussel is a species with a waterborne larval stage and adults that settle on hard

surfaces, which greatly reduces the time frame to act because currents and vessel related transport can facilitate its range expansion. The mussel was first reported in one of the Great Lakes in 1986, reported in all the Great Lakes by 1989, and moved down the Mississippi River to New Orleans by 1993 (O'Neill and Dextrase 1994, Niimi, unpublished data).

The nature of an individual EAS should be considered when assessing risk. A single specimen of a sexually-reproducing fish found in one lake poses less potential risk than one specimen of an invertebrate species with marked asexual powers of reproduction found in the same lake. Of the 162 EAS that have become established in the Great Lakes basin (Grigorovich et al. 2003), only about 13 species have been shown to pose serious ecological threat to other species (Mills et al. 1993). Thus, the risk posed is not the same for all EAS. What will determine the relative risk from a given species is its potential to compete ecologically with a closely-related species, to be relatively free from predation, or to exploit aggressively a niche in a lake or river community, as determined by its life history characteristics (Ricciardi and Rasmussen 1998;Kolar and Lodge 2002). The community structure of the Laurentian Great Lakes (and many others) has been changed profoundly by many deliberate introductions of fish species during the last century (Crawford 2001), not to mention the presence of many EAS (Yan and Pawson 1997). Therefore, the ecological risks posed by a particular EAS must be assessed against this background (Ricciardi, 2001).

AMENDING EMERGENCY REGULATIONS FOR EXOTIC SPECIES MANAGEMENT

Emergency response type legislation exists in Canada, at both the federal and provincial levels, that if amended, could be used, potentially, to address EAS and a fast action response to new invaders. Such legislation was not developed originally for EAS, but does, in some cases, include damage to the environment as an emergency, and a reason for prompt action beyond normal procedures. The definition of emergency or disaster in the legislation is what determines if the emergency type legislation is applicable or not. In some cases, the definition of emergency is quite vague and hence could be interpreted to include the environment. In these cases, amendment of the legislation to include explicitly environmental damage as a form of emergency would more readily provide provisions for the management of EAS. In turn, if the invasions of new EAS were considered to cause an environmental emergency, then provisions for a fast action response to eradicate such species could be established under emergency response type legislation.

DISCUSSION

The Efficacy of Existing Legislation

Global biodiversity is changing rapidly, and the successful establishment of EAS has been implicated as the major driving factor for biodiversity change in both lakes and streams (Sala et al. 2000). This situation is likely to be confounded further by the effects of global warming that increase the possibility of EAS from warmer climatic regions becoming established in Canadian waters (Niimi 2004). There is a number of hard and soft laws that Canada and the

U.S. have enacted to help control and manage EAS. The majority of EAS that have become established in the Great Lakes originated from ballast water. If passage of the two U.S. federal laws requiring NOBOB vessels to undergo inspection is achieved, and improved technology to treat ballast water is developed, then this traditional vector of EAS into Canadian waters will be minimized. However, the projected increases in commercial aquaculture, with its inevitable escapees, may mean that aquaculture and other branches of the exotic fish trade could emerge as the principal future vectors of EAS (Kolar and Lodge 2002).

While much of the focus of research has thus far been on fresh water bodies, it is becoming apparent that exotic marine species are presenting new ecological and economic problems. As an example of this, consider the escape of aquacultured Atlantic salmon (*Salmo salar*) from coastal waters of British Columbia, and their successful reproduction in coastal rivers. Another realized example is the red king crab (*Paralithodes camtschatica*), a native of northern Pacific waters that has been introduced into the northeast Atlantic to promote the crab fishery (Orlov and Ivanov 1978), but which acts as a predator of other commercially valuable species (Rafter et al. 1996).

Other EAS issues, apart from ballast water, have not been adequately addressed for any of the jurisdictions included in this study. The legislative measures developed thus far, especially in the U.S., have focused on the prevention of entry. Given that this is never perfect, and that agencies still have to address the spread of exotic species already introduced into North America, there should be developed a capacity to manage introduce exotics that pose threats, and this can be accomplished only by creating the basis for fast action response.

This analysis revealed that legislative deficiencies exist at the bilateral, federal and provincial/state jurisdictional levels for the prevention and control of EAS through the identified pathways, and also with respect to regulations for a fast action response to newly-discovered EAS. The U.S. has enacted enabling legislation to address EAS prevention and control through ballast water, independently of Canada. Canada has not reciprocated with mandatory regulations, but instead has developed mandatory guidelines for ballast water exchange. However, these are still guidelines, and not binding regulations. Despite current regulations and guidelines for ballast water exchange, new introductions and spread of exiting EAS continues. This is due, largely, to a "loophole" in the regulations that do not currently address NOBOB vessels. However, it is important to note that if the two pending U.S. federal bills, the *National Aquatic Invasive Species Act* (2003), and the *Great Lakes Ecology Protection Act* (2003) are passed, then this loophole will be, largely, closed on the U.S. side, especially after new mandatory ballast water regulations become enforced in late 2004 under the U.S. *Nonindigenous Aquatic Nuisance Prevention and Control Act.*

Similarly, at the state jurisdictional level, the majority of states examined in this study have proposed ballast water legislation, that if passed, would be consistent and complementary to current U.S. federal regulations. The Canadian provinces examined in this study have not proposed ballast water legislation. It is important to note however, that the Vancouver Port Authority has developed its own mandatory ballast water exchange program that has been extended to other British Columbia ports, including the ports of Fraser and Nanaimo. This represents a proactive approach by these ports to prevent the introduction of new EAS. Similar mandatory ballast water exchange programs have not been adopted by other Canadian or U.S. ports (on the Atlantic and Pacific coasts).

This analysis also identified a large discrepancy in the current lists of exotic invasive species at both the federal and provincial/state levels. This presents a problem because it means that

some exotic species may be restricted and prohibited in certain jurisdictions but not in others, and such inconsistencies in regulations and prohibitions may potentially allow for the introduction and spread of EAS from regions that are less heavily regulated. In order to deal with this problem, a single list of exotic invasive species should be identified and used to develop regulations and prohibitions for all the jurisdictions included in this study. This would allow for consistency with respect to restricted and prohibited species for the aquaculture, baitfish, fish sale/fish markets, and aquarium pet trade industries.

Apart from the shipping industry, EAS are known to be introduced and spread through secondary vectors such as the aquaculture industry, through garden releases, and baitfish releases, such that one in every four fish species introduced into the U.S. results from the aquarium trade (Reeves 1999, Dextrase and Paleczny 2000). The live fish market is a real pathway for the introduction and spread of EAS. There appears to be a major gap in Canadian and U.S. legislation at the provincial and state jurisdictional levels for the prevention and control of EAS through these secondary vectors. The aquaculture and bait fish industries appear to be the most heavily regulated in the majority of provinces and states examined. However, the list of restricted and prohibited species for use in these two industries varies from jurisdiction to jurisdiction, which may be problematic. The fish sale/fish market and the aquarium pet trade industries are the least heavily regulated, and in some jurisdictions the aquarium pet trade industry is not regulated at all. Given the rate at which EAS are being introduced and spreading through Canadian and U.S. waters, the most realistic approach would be for the Canadian and U.S. federal and provincial/state jurisdictions to amend existing legislation to include provisions to address these gaps, especially to develop legislation to close the loophole in regulations for the aquarium pet trade industry, and to strengthen regulations for the fish sales/fish market industry.

Preventing the introduction and successful establishment of EAS is the most important way to control and manage for EAS. This study examined the current legal capacity of Canada at the federal and provincial levels to undertake a fast action response type of control and management when a new deleterious species enters the country. Emergency response type legislation was examined under the premise that invasions by EAS constitute an environmental emergency, and provisions for developing a fast action response could be developed under this type of legislation. This analysis revealed that the Canadian federal government and the provincial governments included in this study did not, for the most part, include environmental degradation in the definition of emergency. Instead, the emphasis on the human population in the legislation of some provinces precludes these Acts' application to the control of EAS. The majority of the emergency type legislation examined, in its present form, can not be used to address invasive species control. However, if "emergency" were redefined to include explicitly environmental degradation, then provisions for EAS control and management through the development and implementation of a fast action response could be developed under these pieces of legislation.

Suggested Legislative Amendments

For the sake of expediency, all of the dimensions related to management (agency delegation, mandate, monitoring, decision making, funding, actual management, and evaluations of actions) need to be embraced under a single piece of national legislation to facilitate the rapid response to a particular EAS. While recognizing that boundary waters and oceanic waters around North America are under federal jurisdiction, such legislation also

imparts consistency of provisions throughout all regions of Canada and the U.S., involving situations both within each country and between them. Federal legislation can also be the legal means through which each country can discharge its international obligations to control exotic species introductions. Moreover, the presence of strong federal legislation creates an impetus for states or provinces to create their own complementary legislation, as their jurisdiction permits. An example of this is the array of legislation created, or being developed in the U.S. states around the Great Lakes that complement the federal Acts (Vásárhelyi and Thomas 2003). However, it is also highly desirable for individual states and provinces to have the authority to take action on a particular EAS, especially when it arises from a local activity that is not within federal jurisdiction.

In Canada, there is no federal legislation that is equivalent to the U.S. *Nonindigenous Aquatic Nuisance Prevention and Control Act* (1990). Several pieces of existing legislation could be amended to authorize rapid response type management to a given EAS situation. Whichever Act were selected, there would need to be re-definition of terms to define what qualified for action, the basis for determining that action be taken, and removal of discretionary provisions in the Act so that management is actually deployed when the environmental conditions warrant it. In this regard, the events leading to the rapid eradication of the black striped mussel in Australia, and the alga, *C. taxifolia*, and the polychaete worm, *T. heterouncinata*, in the U.S., could guide the creation of provisions in Canadian law.

Of the three pieces of federal law identified in this report (*Fisheries Act, Canada Water Act,* and *the Canada Wildlife Act*) as having the potential to be used to authorize fast action responses, the *Fisheries Act* emerges as the best candidate legislation. Cosgrove (2002) indicated how certain parts of the *Fisheries Act* could be used to authorize management of EAS, especially Sections 36 and 43. Vásárhelyi and Thomas (2003) specified how re-definition of terms in this Act could help create such provision. The *Fisheries Act* is a broad piece of legislation that contains provisions for habitat protection from contaminants, as well as outdated regulations concerning ballast from ships. This Act is administered through the Department of Fisheries and Oceans which has presence and facilities in all the regions of Canada where EAS issues are likely to arise. This government agency also contains the Canadian Coast Guard, whose logistic arm would be vital in the physical act of controlling a given EAS in lakes and coastal areas.

An agreement between the federal government of Canada and the provinces allows the provinces to set their own regulations under the federal *Fisheries Act*, so promoting better federal-provincial relations.

The federal government could use the *Fisheries Act* to discharge its outstanding international obligations concerning EAS prevention and control. Simultaneously, this Act could authorize collaboration with the Federal government of the U.S. on matters of mutual interest in the active management of EAS.

While the suggested use of the *Fisheries Act* could put federal jurisdictions in order, there remains the issue of achieving parallel management provisions in areas where provincial jurisdictions prevail, as in the case of the pet fish trade, fish markets, baitfish, and regulating aquaculture. This report reveals that, among the provinces, there is a great deal of inconsistency in the strength of provisions to deal with EAS that have escaped from captivity. Ideally, there needs to be revision of all the provincial legislation dealing with commerce in exotic fish species, so that there is a harmonization of future federal and provincial laws on this issue.

In the area of ballast water control, the federal government of Canada has already made progress by adopting, in 2000, the *Guidelines for the Control of Ballast Waters from Ships in Waters Under Canadian Jurisdiction.* Moreover, the existing provisions of *Canada Shipping Act* to prevent pollution from ballast discharge could be used to translate guidelines into enforceable regulations. It is advisable to retain the *Canada Shipping Act* for this purpose, insofar as one is regulating the activity and practices of ships in order to prevent introduction of EAS into Canadian waters. The *Fisheries Act* is best suited for authorizing the control and fast action response to those exotic species that have been introduced, and have been determined to pose significant risks.

In the U.S., recent passage of the Mandatory Ballast Water Management Program under the *Nonindigenous Aquatic Nuisance Prevention and Control Act* for U.S. Waters (effective from September 27, 2004) now means that all commercial ships entering any U.S. port, or simply entering U.S. waters, must have completed a mandatory ballast water exchange. The Act extends this requirement to all parts of the country, and, more importantly, converts the former voluntary ballast water program into a mandatory program with legal obligation of vessels to comply, or risk prosecution. This program is a preventative action program, and the role of the U.S. Coast Guard (now under the Department of Homeland Security) can be compared to that of Transport Canada in its role of applying ballast water guidelines to shipping in Canadian waters.

This U.S. law will take effect in September, 2004, and emphasizes the difference between the U.S. and the Canadian approaches. In June, 2002, the U.S. Coast Guard "determined that the voluntary ballast water program is inadequate because sufficient compliance has not occurred". Hence the passage of the mandatory program (Department of Homeland Security 2004). Against this, Canada still adheres to voluntary guidelines. The U.S. Coast Guard endorses any international coordination with Canada and Mexico to prevent EAS introductions (Department of Homeland Security 2004). This leads to the recommendation that the Department of Transport convert their *Guidelines* for ballast water control adopted in 2000 to mandatory regulations under the *Canada Shipping Act,* and in so doing, align the Canadian approach with the U.S. approach.

In the U.S., *Bill 1080*, the *National Invasive Species Act of 2003*, is a piece of federal legislation that is well placed to take on the provisions of authorizing fast action response to EAS. This legislation in waiting already reflects a growing commitment to controlling EAS introductions through ballast waters, i.e. the preventative approach. Moreover, s. 301 includes a provision for early detection of new exotic species, and s. 302 adds the provision for fast action response to a nuisance EAS. Thus, passage of this Bill would give the US government a powerful legal tool to address both the prevention and the control of EAS. The successful fast action control of the alga *C. taxifolia* in Carlsbad, CA, in 2000 indicates that this management capacity is needed urgently throughout the U.S.

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Appendix 1

Bilateral Legislation and Agreements

International Boundary Waters Treaty Act (R.S. 1985, c. 1-17)
Great Lakes Water Quality Agreement (1972, as amended in 1978, 1983, 1987)
The North American Agreement for Environmental Cooperation (NAAEC) (1993)
Convention on Great Lakes Fisheries (1954)
United Nations Conference on Environment and Development (1992) Agenda 21

Federal Statutes and Regulations

Canada

Canada Shipping Act (2001, c. 26)
Fisheries Act 1985 (R.S. 1985, c. F-14)
Canada Water Act 1985 (R.S. 1985, C-11)
Canada Wildlife Act 1985 (R.S. 1985, c.-W-9)
Emergency Preparedness Act (R.S., 1985, c. 6) (4th Supp.)

United States

Nonindigenous Aquatic Nuisance Prevention and Control Act (1990)
National Invasive Species Act (1996) (16 U.S.C. 4701-4702, 4711, 4722, 4751 et.seq., §§1101-1104, 1202, 1203)
Lacey Act (1900)
Executive Order 13112 (1999)
Great Lakes Fish and Wildlife Restoration Act (1990)
Great Lakes Legacy Act (2002)
National Aquatic Invasive Species Act of 2002 H.R. 1080 (bill pending)
Great Lakes Ecology Protection Act of 2003 S., H.R. 989 (bill pending)

Provincial and State Statutes and Regulations

Canada

Newfoundland and Labrador

Environmental Protection Act (2002 c. E-14.2)
Aquaculture Act (1991 c. 36 as amended)
Fish Inspection Regulation (O.C. 96-934)
Emergency Measures Act (1990 c. E-8)
Wildlife Regulation (Reg. 1156/96)

Nova Scotia

Wildlife Act (R.S., c. 504, s.2)
Fisheries and Coastal Resources Act (1996, C. 25, s. 1)
General Wildlife Regulations (N.S. Reg. 205/87, as amended)
Maritime Provinces Fishery Regulations (SOR 193-55)
Emergency Measures Act (1990 c. 8)

Prince Edward Island

Wildlife Conservation Act (c. W-4.1)
Fish and Game Protection Act - General Regulations (EC818/66)

Fisheries Act (c. F-13.01)
Maritime Provinces Fishery Regulations (SOR 193-55)
Emergency Measures Act (1990 c. 11)

New Brunswick
Fish and Wildlife Act (F-14.1)
Exotic Wildlife Regulation (Reg. 92-74)
Aquaculture Act (c. A-9.2)
General Regulations (Reg. 91-158)
Fish Inspection Act (c. F-18)
Fish Inspection Act Regulation (Reg. 84-24)
Maritime Provinces Fishery Regulations (SOR 193-55)
Emergency Measures Act (1978 c. E-7.1)

Quebec
An Act Respecting the Conservation and Development of Wildlife (R.S.Q.c. C-61.1)
Regulation Respecting Aquaculture and the Sale of Fish (R.R.Q.c. C-61.1 r.0.002, O.C. 1302-94)
Civil Protection Act (R.S.Q. S-2.3)

Ontario
Fish and Wildlife Conservation Act (S.O. 1997 c. 41)
Environmental Protection Act (R.S.O. 1990 c. E. 19)
Fish Licensing Regulation (O. Reg. 664/98)
Emergency Management Act (1990 c. E. 9)

British Columbia
Fisheries Act (RSBC 1996 c. 149)
Fisheries Act Regulations (includes amendments up to B.C. Reg. 109/2002)
Wildlife Act (RSBC 1996 c. 488)
Aquaculture Regulation (B.C. Reg. 78/2002, O.C. 283/2002)
Fish Inspection Act (RSBC 1996 c. 148)
British Columbia Sport Fishing Regulation (SOR/96-137)
Emergency Program Act (RSBC 1996 c.111)

United States

Maine
An Act to Prevent Infestation of Invasive Aquatic Plants and to Control Other Invasive Species Chapter 434 S.P. 630-L.D. 1812
12 *Maine Revised Statute* 665-2
12 *Maine Revised Statute* 923-3
12 *Maine Revised Statute* 707-6
12 *Maine Revised Statute* 711-3

New York
New York Environmental Conservation Law (11-05-1, 11-13.9, 11-13.5)
6 *New York Consolidated Rules and Regulation* 48 (13-1316)
New York Environmental Conservation Law (13-1316)
New York Environmental Conservation Law (11-1911,11-1909,11-1913)

Pennsylvania

58 *Pennsylvania Code* 71
58 *Pennsylvania Code* 63
3 *Pennsylvania Consolidated Statutes* 4219, 4220, 4221
30 *Pennsylvania Consolidated Statute* 2507
58 *Pennsylvania Code* 73

Ohio

Ohio Revised Code Ann. 1533.
Ohio Administrative Code 1501: 31-39
Ohio Administrative Code 1501: 31-13
Ohio Administrative Code 1501: 31-1

Michigan

Michigan Aquaculture Development Act (1996 MCLS 286)
Natural Resources and Environmental Protection Act (1994 MCLS 324)

Illinois

Fish and Aquatic Life Code (515 ILCS 5/)
17 *Illinois Administrative Code* 805

Indiana

312 *Indiana Administrative Code* 9-10
Indiana Administrative Code 9-6
Indiana Statute Ann 14-22-6

Wisconsin

Wisconsin Statute 95
Wisconsin Statute 29
Wisconsin Administrative Code NR 16

Minnesota

Minnesota Statute 84D
Minnesota Statute 17
Minnesota Rule 6216
Minnesota Statute 97C

Washington

Revised Code of Washington 77.125
Washington Administrative Code 16-603
Washington Administrative Code 220-76
Washington Administrative Code 232-12
Washington Administrative Code 12-01701